09/647994

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Attention: Box PCT - DESIGNATED/ELECTED OFFICE (DO/EO/US)

FORM PTO-1390 (REV 5-93) — U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER: 36636-166651
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		U.S. APPLICATION NO. (If known, see 37 CFR 1 5): Not Yet Assigned 09/647994
INTERNATIONAL APPLICATION NO.: PCT/DK99/00171	INTERNATIONAL FILING DATE: March 25, 1999	PRIORITY DATE CLAIMED: April 8, 1998
TITLE OF INVENTION: - see attached pages -		
APPLICANT(S) FOR DO/EO/US: - see attached pages -		

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. X This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
3. X This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(l).

- See attached pages for additional data –

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October 10, 2000 422 Rec'd PCT/PTO 10 OCT 2000

Assistant Commissioner for Patents
Washington, D.C. 20231

Attorney Docket: 36636-166651 JPS

Attention: PCT-DO/US

Re: International Application PCT/DK99/0017 filed March 25, 1999
Priority Claimed: Denmark Appl. No. 0494/98 filed 7 April 1998

Inventors: Jens Jørren SØRENSEN
Blekingegade 1
DK-2300 COPENHAGEN
DENMARK

Title: A METHOD AND AN APPARATUS FOR TRANSFER OF PRESSURE AND/OR TENSILE LOAD AND ELONGATE CHAIN FOR USE THEREIN

Sir:

Submitted herewith, as the first submission, are the following for the purposes of entering the national stage for the USA under 35 U.S.C. 371**(c), immediate national examination under 35 U.S.C. 371(f) being requested**.

X English-language International Application No. PCT/DK99/00171 published as WO 99/53221 with English-language International Search Report issued by the Swedish Patent Office.

X Translation of International Application

X Eleven (11) Sheets of Formal Drawings

X International Preliminary Examination Report (IPER)

X Translation of IPER Annexes

X Preliminary Amendment

Fees: (see formula below) Check Enclosed

Basic National Fee.....	$ 1000.00
29 Additional claims in excess of twenty	$ 522.00

TOTAL FEES FOR THE ABOVE APPLICATION... $1522.00

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Assistant Commissioner for Patents
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In the event there is attached hereto no check, or a check for an insufficient amount, please charge the fee to our Account No. 22-0261 and notify us accordingly.

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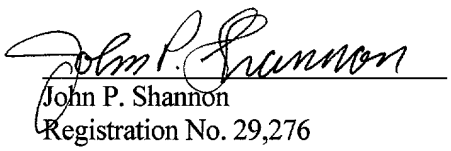
Respectfully submitted,



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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE 09/647994

422 Rec'd PCT/PTO 10 OCT 2000

In Re PATENT APPLICATION of

Applicant	:	Jens SØRRENSEN	
U.S. Appln. No.	:	Not Yet Assigned	
Filed	:	Concurrently	
For	:	A METHOD AND APPARATUS FOR TRANSFER OF PRESSURE AND/OR TENSILE LOAD AND AN ELONGATE CHAIN FOR USE THEREIN	**PRELIMINARY AMENDMENT**
Attorney Docket	:	**36636-166651 JPS**	**October 10, 2000**

Assistant Commissioner for Patents
Washington, D.C. 20231

Attention: PCT DO/EO/US

Sir:

Prior to examination, please amend the above-identified application as follows:

Claim 4, line 1, delete "or 3 ".

Claim 5, line 1, delete "and 4".

Claim 6, line 1, delete " and 4"

Claim 7, line 1, delete " or 3".

Claim 8, line 1, change "any of claims 2 to 7" to – claim 2--.

Claim 9, line 1, change "any of claims 2 to 7" to – claim 2--.

Claim 10, line 1, change "any of claims 2 to 7" to – claim 2--.

Claim 11, line 1, change "any of claims 2 to 7" to – claim 2--.

Claim 12, lines 1 and 2, change "any of the preceding claims" to –claim 1--.

Claim 14, line 1, delete "or 13".

Claim 15, line 1, delete " or 13".

Claim 16, lines 1 and 2, change "any of claims 12 to 15" to –claim 12--.

Claim 20, lines 1 and 2, change " any of claims 16 to 19" to – claim 16 --.

Claim 21, lines 1 and 2, delete "and any of claims 16 to 20"

Claim 23, line 1, delete "or 22" .

Claim 24, lines 1 and 2, change "any of claims 21 to 23" to –claim 21--.

Claim 25, lines 1 and 2, change "any of claims 12 to 24" to –claim 12 --.

Claim 27, lines 1 and 2, change "any of claims 12 to 26" to –claim 12--.

Claim 28, line 1, delete "and 27".

Claim 29, lines 1 and 2 delete "and claim 27".

Claim 30, lines 1 and 2, change "any of claims 12 to 29" to –claim 12--.

Claim 31, lines 1 and 2, change " any of claims 12 to 30" to – claim 12--.

Claim 32, lines 1 and 2, change " any of claims 12 to 30" to – claim 12--.

Claim 33, lines 1 and 2, change "any of claims 13 to 30" to – claim 13--.

Claim 34, lines 1 and 2, change "any of claims 12 to 30" to – claim 12--.

Claim 35, line 3, change "any of claim 12 to 34" to –claim 12—

Claim 36, line 2, delete "for use in an apparatus according to claim 17"

Claim 37, lines 1 and 2, delete "for use in an apparatus according to claim 18"

Claim 39, line 1, change "any of claims 35 to 38 for use in an apparatus according to claim 20"

to --claim 35—.

Claim 41, lines 1 and 2, change "any of claims 35 to 40 for use in an apparatus according to claim 22"

to –claim 35 --.

Claim 42, lines 1 and 2, delete "and 41 for use in an apparatus according to claim 18"

Claim 44, lines 1 and 2, change "any of claims 35 to 43 for use in an apparatus according to claim 23"

to –claim 35 --.

Claim 45, line 1, change "any of claims 35 to 44" to –claim 35--.

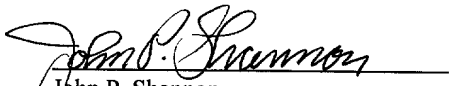
Claim 48, line 1, change "any of claims 35 to 47" to –claim 35--.

Claim 49, line 1 change "any of claims 35 to 47" to – claim 35--.

REMARKS

The above changes are to the claims appearing in the Annexes to the International Preliminary Examination Report. Those claims should have been entered, but if not entered, such entry is hereby requested. The claims have been amended to eliminate multiple claim dependency. The Examiner's attention is directed to the International Preliminary Examination Report.

Respectfully submitted,



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A method and an apparatus for transfer of pressure and/or tensile load.

The present invention relates to a method and an apparatus for transfer of pressure and/or tensile load between two objects.

According to the invention a transfer of pressure and/or tensile and possibly torque loads between two mutually movable objects is provided, which is suitably applicable for a number of practical purposes and based on hitherto unknown mechanical principles. Non-exhaustive examples of fields of use aimed at by the invention may be raising/lowering devices for mutually height displaceable objects, for instance jacks or motor-operated lifting devices of any kind, and operator mechanisms for the opening and closing of windows, doors and gates.

The method according to the invention is characterized in that an elongate spindle member with high rigidity and stability against pressure and/or tensile load as well as bending and torsional load is provided by winding-up of mutually interlocking chain links under axial displacement in a helical winding by means of a winding guide means connected with one of said two objects and a driving device, a coupling member being provided for connection of the helical winding with the other of said two objects, each chain link being retained in engagement with neighbouring links in the same turn as well as adjacent chain links in neighbouring turns.

By winding mutually interlocked chain links in this manner in a helical winding under active retainment of the individual chain links in their positions in the helical winding, it has turned out to be possible to provide a spindle device having significant stability against pressure and/or tensile loads as

cant stability against pressure and/or tensile loads as well as bending and torsional loads and which may act as a pressure bar or drawbar or torque shaft between two objects.

According to a preferred embodiment of the method of the invention a reversibly rotatable driving device is used, said device increasing by rotation in one direction of rotation the length of the spindle device during winding of the chain links in said helical winding and reduces by rotation in the opposite direction of rotation the length of the spindle device during unwinding of the chain links from said helical winding.

Further embodiments of the method and non-exhaustive examples of its application are described in the dependent claims 2 - 11.

For carrying out the method the apparatus according to the invention is characterized in comprising, in connection with one of said two objects, a chain storage with an elongate chain of interlocking chain links, a guide means for advancing the elongate chain, and a winding guide means connected with the advancing guide means for winding said helical winding and comprising a guide for engagement with a guide member on the chain links, whereas a coupling member is provided for connection of said helical wnding with the other of said two objects, a driving means being provided for axial advancement of the spindle device produced by the helical winding.

Advantageous embodiments of the apparatus and its individual components as well as non-exhaustive examples of use are described in the dependent claims 13 to 44.

The invention will be explained in the following by means of an embodiment and with reference to the

partly schematic drawing, in which

Figs 1 and 2 are schematic, perspective views illustrating the principle of the method according to the invention,

Figs 3 and 4 show an embodiment of an apparatus according to the invention,

Fig. 5 shows and embodiment of the apparatus with integrated chain storage,

Figs 6 and 7 show embodiments of a winding guide means and a drive means in the apparatus according to Figs 3 and 4,

Figs 8 - 12 show an embodiment of a chain link for use in the apparatus according to Figs 3 and 4,

Fig. 14 is a perspective view illustrating the winding up of the interlocking chain links in a helical winding under mutual retainment,

Fig. 15 is a schematical perspective view of a first alternative embodiment, in which two spindle members of equal diameter are formed by individual helical windings produced from individual sets of chain links,

Fig. 16 is a schematical sectional view of a second alternative embodiment, in which two spindle members of different diameter are formed by individual helical windings produced from individual sets of chain links and extending one inside the other,

Fig. 17 is a schematical perspective view of an alternative embodiment, in which a single spindle device is formed from two individual sets of chain links, and

Fig. 18 is a perspective view of the application of the embodiment shown in fig. 15 in a window operator device.

As will appear from figs 1 and 2, the invention resides in its broadest aspect in that chain links 1,

A method and an apparatus for transfer of pressure and/or tensile load and an elongate chain for use therein.

The present invention relates to a method and an apparatus of making an elongate spindle member having significant rigidity and stability against pressure and/or tensile loads as well as bending and torsional loads, whereby said spindle member acts between two objects.

According to the invention a transfer of pressure and/or tensile and possibly torque loads between two mutually movable objects is provided, which is suitably applicable for a number of practical purposes and based on hitherto unknown mechanical principles. Non-exhaustive examples of fields of use aimed at by the invention may be raising/lowering devices for mutually height displaceable objects, for instance jacks or motor-operated lifting devices of any kind, and operator mechanisms for the opening and closing of windows, doors and gates.

The method according to the invention comprises the steps of

- winding-up of a plurality of mutually interlocking chain links under axial displacement in a helical winding to form said elongate spindle member,
- using chain links formed with a substantially circular curvature on their exterior sides and including associated engagement means,
- drivingly connecting said chain links to a rotatable driving device arranged in a winding guide means connected with one of said two objects,
- guiding said chain links during rotation of said driving device in said winding guide means so that the chain links are interconnected and retained in engagement by their associated engagement means with neigh-

bouring chain links in the same turn as well as adjacent chain links in neighbouring turns of said elongate spindle member, and

- coupling the helical winding with the other of said two objects by means of a cupling member.

By winding mutually interlocked chain links in this manner in a helical winding under active retainment of the individual chain links in their positions in the helical winding, it has turned out to be possible to provide a spindle device having significant stability against pressure and/or tensile loads as well as bending and torsional loads and which may act as a pressure bar or drawbar or torque shaft between two objects.

According to a preferred embodiment of the method of the invention a reversibly rotatable driving device is used, said device increasing by rotation in one direction of rotation the length of the spindle device during winding of the chain links in said helical winding and reduces by rotation in the opposite direction of rotation the length of the spindle device during unwinding of the chain links from said helical winding.

Further embodiments of the method and non-exhaustive examples of its application are described in the dependent claims 2 - 11.

For carrying out the method the apparatus according to the invention is characterized in comprising, in connection with one of said two objects, a chain storage with an elongate chain of interlocking chain links having a substantially circular curvature on their exterior sides and including associated engagement means, a guide means for advancing the elongate chain, a winding guide means connected with the advancing guide means and comprising a guide for engagement

with a guide member on the chain links for winding said helical winding a rotatable driving device arranged in said winding guide means axial advancement of the spindle device produced by the helical winding and a coupling member for coupling the helical winding with the other of said two objects.

Advantageous embodiments of the apparatus and non-exhaustive examples of use are described in the dependent claims 13 to 34.

The invention further relates to an elongate chain comprising interlocking chain links with associated engagement means for use in the apparatus.

According to the invention the elongate chain is characterized in each chain link has a substantially circular curvature on its exterior sides and, in unfolded projection, substantially the shape of a parallelogram with a first pair of engagement means for connection with neighbouring chain links in the same turn of the helical winding provided at a first pair of opposite sides and further engagement means for engagement with corresponding engagement means on adjacent chain links in neighbouring turns of the helical winding provided at a second pair of opposite sides.

The invention will be explained in the following by means of an embodiment and with reference to the partly schematic drawing, in which

Figs 1 and 2 are schematic, perspective views illustrating the principle of the method according to the invention,

Figs 3 and 4 show an embodiment of an apparatus according to the invention,

Fig. 5 shows and embodiment of the apparatus with integrated chain storage,

Figs 6 and 7 show embodiments of a winding guide means and a drive means in the apparatus according to

Figs 3 and 4,

Figs 8 - 12 show an embodiment of a chain link for use in the apparatus according to Figs 3 and 4,

Fig. 14 is a perspective view illustrating the winding up of the interlocking chain links in a helical winding under mutual retainment,

Fig. 15 is a schematical perspective view of a first alternative embodiment, in which two spindle members of equal diameter are formed by individual helical windings produced from individual sets of chain links,

Fig. 16 is a schematical sectional view of a second alternative embodiment, in which two spindle members of different diameter are formed by individual helical windings produced from individual sets of chain links and extending one inside the other,

Fig. 17 is a schematical perspective view of an alternative embodiment, in which a single spindle device is formed from two individual sets of chain links, and

Fig. 18 is a perspective view of the application of the embodiment shown in fig. 15 in a window operator device.

As will appear from figs 1 and 2, the invention resides in its broadest aspect in that chain links 1,

which are mutually interlocked into an elongate chain 2, are wound into a helical winding 5 under mutual retainment by means of a drive means comprising an advancing wheel 3 in connection with a drive wheel 4 which may be connected via a transmission with a preferably reversibly rotatable drive motor (not shown), and by use of advancing and winding guide means.

The wound up helical winding thereby forms a spindle device of variable length and considerable rigidity and stability against pressure, tensile, bending and torsional loads.

The winding up of the chain links 1 in the helical winding 5 takes place during rotation of the drive wheel 4 in one direction of rotation, the length of the spindle device being increased under axial advancement and simultaneous rotation of the helical winding. If the direction of rotation of the drive wheel 4 is reversed, the chain links 1 will again become unwound from the helical winding 5 and the spindle device formed thereby will be shortened.

When carrying out the method, a chain storage (not shown in figs 1 and 2) will be provided, together with advancing and winding guide means (not shown) and the driving device in connection with one of the two objects, between which a power transfer is wanted, preferably a stationary first object, while a second object movable relative thereto may be connected, as shown in the intersected view in fig. 2, with the spindle device 5 by means of a coupling member 6, which at the start of the winding up of the chain links 1 is connected with the turn 7 first formed in the helical winding 5.

As will likewise appear from fig. 2, the spindle device formed by the helical winding 5 will for many

practical uses be protected by a surrounding, elongate cover member of variable length, for instance a bellow 8.

Based on the embodiment shown in figs 3 and 4 of an apparatus according to the invention examples of the design of the individual components of the apparatus will be explained in the following.

In the embodiment shown in figs 3 and 4, the mutually interlocked chain links 12 are advanced in an elongate chain 11 from a chain storage (not shown) by means of a substantially linear advancing guide member 13 towards a winding guide member 14, in which the drive means with the drive wheel 15 and the advancing wheel (not shown) are journalled by means of bearing means (not shown).

By clockwise rotation of the drive wheel 15, the chain links 12 are wound, guided by the winding guide means 14, in the helical winding 16, in which the chain links 12 are positioned in closely packed turns 17 under mutual retainment, such that the wound up chain links are prevented from mutual displacement in the helical winding.

In the winding guide means 14, the chain links 12 first arriving are brought into engagement with a coupling member 18 shown in fig. 3. While the advancing guide means 13, the winding guide means 14 and the drive means with the drive wheel 15 are placed in connection with one of the two objects, between which pressure and/or tensile as well as torque loads are to be transferred by means of the apparatus, the coupling member 18 serves for connecting the spindle device 16 with the other of the two objects. The drive means may alternatively, together with the coupling member, be positioned in connection with the second object.

Fig. 5 shows, in a schematic plane view, how the

winding up guide means 14 and the advancing guide means 13 may be integrated in a common housing 9 with a chain storage in the shape of a track 10, in which the elongate chain 11 is received in its entire length.

The advancing guide means 13 is in the embodiment shown designed as a linear rail member with a bottom surface 19 forming an elongate advancing guide surface for a convex exterior side of the interlocked chain links 12, and a superjacent guide rail 20 which by engagement with engagement means at a concave interior side of the chain links 12 guides them safely towards the winding up guide means 14.

The winding up guide means 14 is in the embodiment shown in fig. 6 formed with a substantially part-cylindrical wall 21, on the interior side of which a winding guide is formed by a thread-rib 22, which in the embodiment shown extends with a predetermined pitch across slightly more than 360° of the interior periphery of the wall 21. At one end 23 of the thread-rib 22, the interior side of the part-cylindrical wall 21 joins in a tangential plane in an extension 24 of the advancing guide surface 19. An advancing guide means 25 in the form of a protruding member for engagement with a track in the exterior side of the chain links 12 is connected with the advancing guide surface 24. This will be explained in detail in the following.

In the embodiment of the drive means shown in fig. 7, the drive means 15 is connected with an advancing wheel 26 which is provided, in a peripheral surface, with a number of oblique teeth with a predetermined pitch directed oppositely to the pitch of the threaded groove 22 on the interior side of the cylindrical wall 21 in the winding guide means 14. As will be explained in detail in the following, the advancing wheel 26 with the teeth 27 engages, during winding up of the chain

links 12, a helical track in the interior side of the chain links 12 and thereby brings about an axial advancement of the helical winding provided during winding-up under simultaneous rotation of the helical winding about its axis.

As will be seen from the projected view in fig. 12, the individual chain links 12 have, in an unfolded projection, substantially the shape of a parallelogram with a first pair of opposite sides 28 and 29 and a second pair of opposite sides 30 and 31.

As more clearly seen in figs 8 - 11 the chain links 12 have a substantially circular curvature with a convex exterior side 32 and a concave interior side 33, such that, when wound up, the chain links 12 form the substantially circular-cylindrical helical winding 16. To prevent joints between chain links 12 in the individual turns 17 in the helical winding 16 from being positioned diametrally opposite one another, the chains 12 have a length differing from an even circle fraction, preferably with an odd number of chain links 12 in each turn depending on the desired dimensions of the helical winding made. In practice, 5 chain links per turn have proved suitable for many purposes, such as will be most clearly seen from figs. 5 and 14.

For engagement with the winding guide in the winding guide means 14 formed by the thread-rib 22, a substantially linear track 34 is provided as a guide member in the convex exterior side 32 of each chain link, said track forming with the first pair of opposite sides 28 and 29 an angle v determined by the pitch angle of the thread-rib 22 relative to the axis of the part-cylindrical wall 21 of the winding guide means 14.

For engagement with the member 25 protruding as an advancing guide member from the extension 24 of the advancing guide surface, each chain link 12 comprises

in the convex exterior side 32 as a second guide member a track 35 with two axially displaced track portions 35a and 35b which in each of a first pair of opposite sides 28 and 29 of the chain link 12 end in track orifices 36, 37 displaced in a direction parallel with the sides 28, 29. This design of the track brings each chain link 12 from the advancing guide surface 19, 24 into the winding guide means 14 with an axial displacement component and the orifice 38 of the track 34 at the downstream side 28 in the advancing direction, will be orientated against and aligned with the inlet end 23 of the thread-rib 22.

For engagement with the oblique teeth 27 on the advancing wheel 26 in the embodiment shown, a helical track 39 is provided in the concave interior side 33 of each chain link, as shown in Figs 10 and 11, said track being in the embodiment shown oriented substantially diagonally between track orifices 40 and 41 in each of the second pair of opposite sides 30 and 31. This form of the track has the effect that in the interior side of the wound up helical winding, a number of continuous, coherent helical tracks 42 is formed for engagement with each theirs of the corresponding number of oblique teeth 27 on the advancing wheel 26. If the drive means is alternatively connected with the coupling member 18, the interior tracks 39 may be dispensed with. Thereby, the chain links may ultimately be formed so as to substantially close the internal cavity of the spindle device to improve the rigidity and stability thereof.

For retaining the individual chain links 12 in their mutual positions in the turn 17 of the helical winding 16, each chain link 12 is provided with various pairs of co-operating engagement means.

Thus, a first pair of co-operating engagement

means for connecting each chain link 12 with its neighbouring chain links comprises a curved track 43 and a hook-shaped hinge member 44 at each of the first pair of opposite sides 28 and 29 of the chain link. The shape of the track 43 and the hinge member received therein are adapted to one another and the track 43 has a depth, such that, in the wound up helical winding 16, the hinge member is pushed completely into the groove 43, as shown in Fig. 14.

A second pair of co-operating engagement means comprises a fork member 45 provided in the interior wall 46 of the curved track 43 and a rib member 47 provided at the interior side of the hook-shaped hinge member 44. By the engagement of the fork and rib members 45 and 47 with a rib member 47 and a fork member 45, respectively, on each of neighbouring chain links in the same turn, neighbouring chain links in the same turn 17 are prevented from mutual displacement in the axial direction of the helical winding produced.

On the interior side of the hook-shaped hinge member 44 abutment surfaces 48 for the branches 45a of the fork member 45 are further provided. Through the abutment of the fork branches 45a against the surfaces 48, the winding movement of the chain link 12 is stopped, such that neighbouring chain links in the same turn 17 are retained in their mutual angular position, which is determined by the number of chain links in the turn.

As shown in fig. 3 the fork member 45 further serves as engagement member for the guide rail 20 in the advancing guide means 13.

As will appear from figs 10, 11 and 14 the fork and rib members 45 and 47 on each chain link 12 are further axially displaced relative to one another. Hereby is attained that the curved track 43 in the

entrance side 28 of each chain link at the winding in the helical winding, in addition to maintaining its engagement with the hook-shaped hinge member 44 on the previously introduced chain link 12, is brought into overlapping engagement with the hook-shaped hinge member 44 on the chain link in the turn formed immediately prior thereto in the helical winding 16, which is adjacent to this previously introduced chain link. This engagement has the effect that neighbouring turns 17 in the helical winding 16 are retained against mutual displacement in a plane perpendicular to the axial direction.

Finally, each of the chain links 12 is provided, at each of the second pair of opposite sides 30 and 31, with further engagement means which comprise a track 49 in the convex exterior side 32 of the chain link and a rib member 50 along one and the other side 30 and 31, respectively. By engagement of the track 49 and the rib member 50 with corresponding engagement means on adjacent chain links in neighbouring turns is ensured, by the winding-up of the chain links 12 in the helical winding, that chain links in neighbouring turns positioned side by side are secured in mutual engagement.

The coupling member 18, with which the winding 17 first formed in the helical winding 16 is connected during the winding up of the chain link 12, is in the embodiment shown in Fig. 13 designed as a substantially disc-shaped cover member with a substantially circular-cylindrical edge surface 51, in which a track 52 is provided as a guide member for engaging the thread-rib 22 in the winding guide means 14, said track being substantially identical to the track 34 in the convex exterior side 32 of each chain link.

On the side surface 53 facing the helical winding 16, the coupling member 18 is provided with a number of

protruding engagement means 54 corresponding to the number of chain links 12 in each turn of the helical winding 16, the height of said protruding engagement means 54 from side surface 53 increasing in accordance with the pitch of the wound up helical winding 16.

As the chain links 12, as mentioned above, are introduced in the winding guide means 14 with the side 28 with the curved track 43 in front and the side 31 with the rib member 50 facing outwards towards the coupling member 18, each of the engagement means 54 is provided with a hook-shaped hinge member 55 corresponding to the hook-shaped hinge member 44 on each chain link 12 and with an engagement track 56 for engagement with the rib member 50 on a chain link in the turn first formed.

By providing the chain links 12 and the coupling member 18 with the described co-operating engagement means, the chain links 12 will be safely secured and locked relative to each other in the wound up helical winding 16, which then together with the coupling member 18 provides a spindle device having considerable rigidity and high stability towards pressure and tensional load as well as towards bending, torsional and torque loads.

In fig. 15 an embodiment of the method an apparatus of the invention is illustrated, by which two spindle devices 57 and 58 are formed in linear extension of each other by winding-up chain links 59 and 60, respectively, from individual chains in separate helical windings having the same diameter. By provision of individual advancing guide means and winding guide means for the two spindle devices 57 and 58 at one and the other of the two objects to be interconnected, the chain storage needed to produce a given maximum length of the total spindle device may be evenly distributed

between the two objects.

In each helical winding the first produced turn 61 and 62, respectively, is connected with a coupling member 63 and 64, respectively, which coupling members are connected with each other intermediate the two objects, which are not shown in fig. 15.

The pitch direction of the helical windings of the two spindle devices 57 and 58 are opposite as illustrated by arrows 65 and 66, respectively, so that for the two opposite directions of revolution the length of both spindle devices 57 and 58 will either increase or decrease at the same time.

Fig. 16 shows another alternative embodiment, in which one spindle device 67 of two individual spindle devices 67 and 68 having opposite pitch directions to function in the same way as escribed above, is formed is formed with an external threading 69 engaging an internal threading 70 formed by the helical track in the interior side of the chain links of the other spindle device 68.

Also in this case, the advancing and winding guide means 71 and 72, respectively, for the helical windings of spindle devices 67 and 68 are provided at one and the other of the two objects 73 and 74 constituting e.g. main frame and sash members of an openable window, respectively, whereas each of spindle devices 67 and 68 functions as a coupling member for the other spindle device, so that separate coupling members for the first produced turn of each spindle device are dispensed with. By the simultaneous winding-up of the two spindle devices 67 and 68 from one and the other of the two objects, the spindle device 67 will simply gradually be screwed into the spindle device 68.

By this arrangement the rigidity and stability of the overall spindle resulting from the combination of

the individual spindle devices 67 and 68 is further increased.

Fig. 17 shows a further alternative embodiment, in which a single spindle device 75 is formed by winding-up two separate individual sets of chain links 76 an 77 in alternating turns of the helical winding. The two chains comprising links 76 and 77, respectively, are advanced towards a common winding guide means (not shown) of the same principal construction as shown in figs. 3 and 4 so as to enter the part cylindrical wall of the winding guide means at two points that are preferably diametrically opposite to each other. Compared to the embodiments described hereinbefore the winding guide means must have an internal threaded rib for each of the separate sets of chain links 76 and 77, each of said threaded ribs having a pitch and the form of the external tracks in the chain links corresponding to tracks 34 and 35 i figs. 8 and 9 being dimensioned to impart an axial displacement component to the chain links entering the winding guide means sufficient to allow the winding-up of chain links 72 and 73 in alternating turns.

By this alternating turn design of the spindle device the chain supply needed to produce a spindle device of a given length can be divided into two separate chains arranged on either side of the winding guide means. By use of the apparatus in a window operator this design will facilitate arrangement of the operator housing including the winding guide means in the middle of a main frame or sash member.

Fig. 18 shows an example of application of the embodiment schematically illustrated in fig. 15 in an operator device for a window having a main frame 78 and an openable sash 79, which are pivotally connected with each other by hinge means (not illustrated) provided at

opposed bottom members 80 and 81 of the main frame and sash structures. Operator housings 82 and 83 arranged on opposed top members 84 and 85 of the main frame and sash structures accommodate a chain storage with associated advancing guide means, winding guide means and drive means for the winding-up of chain links from each chain in the helical windings forming the two spindle devices 57 and 58, which are connected end by end by means of the coupling members 63 and 64.

It is within the scope of the invention possible to design the individual components of the apparatus in other ways. The number of chain links in each turn in the helical winding will thus depend on the dimensions of the spindle device suitable for the purpose in question. The coupling member connecting the spindle device with the second one of the two objects to be connected, may be connected with the helical winding in other ways, for instance as shown in Fig. 2 with a bushing member, fastened in the interior of the helical winding. Also the chain links may be designed in other ways, provided the functional conditions in respect of winding, axial advancement in the helical winding and mutual securing be met, the object of said conditions being to prevent relative movement between the individual chain links and between individual turns in the helical winding.

PATENT CLAIMS

1. A method of making an elongate spindle member having significant rigidity and stability against pressure and/or tensile loads as well as bending and torsional loads, whereby said spindle member acts between two objects, comprising the steps of

- winding-up of a plurality of mutually interlocking chain links (1, 12) under axial displacement in a helical winding (5, 16) to form said elongate spindle member,
- using chain links formed with a substantially circular curvature on their exterior sides and including associated engagement means,
- drivingly connecting said chain links to a rotatable driving device (3,4;15,26) arranged in a winding guide means (14) connected with one of said two objects,
- guiding said chain links during rotation of said driving device in said winding guide means so that the chain links are interconnected and retained in engagement by their associated engagement means with neighbouring chain links in the same turn as well as adjacent chain links in neighbouring turns of said elongate spindle member, and
- coupling the helical winding with the other of said two objects by means of a coupling member (6,18).

2. A method according to claim 1, characterized by the use of a reversibly rotatable driving device (3, 4; 15, 26) as said driving device to increase and reduce the length of the spindle member by rotation of said driving device in one and the other direction of rotation, respectively.

3. A method according to claim 2, characterized in that the coupling by means of said coupling member (6, 18) is effected by connection with the first produced turn of the helical winding.

4. A method according to claim 2 or 3, c h a r a c t e r i z e d in that two elongate spindle members (57, 58; 67, 68) are formed by winding-up individual coherent sets of chain links (59, 60) in two helical windings with opposite pitch directions (65, 66), the winding guide means of said sets of chain links being connected with one and the other of said two objects, respectively.

5. A method according to claim 3 and 4, c h a r a c t e r i z e d in that the two helical windings (57, 58) have the same diameter and that coupling members (63, 64) connected with the first produced turn (61, 62) of each winding are connected with each other intermediate said two objects.

6. A method according to claim 2 and 4, c h a r a c t e r i z e d in that one of said helical windings (67) are advanced inside the other (68) and have chain links provided with an external threading (69) to engage an internal threading (70) in the chain links of the other helical winding to enable each of said helical windings to function as a coupling member for the other helical winding.

7. A method according to claim 2 or 3, c h a r a c t e r i z e d in that a single spindle device is formed by winding two separate sets of chain links (76, 77) in alternating turns in the same helical winding, both sets of chain links (72, 73) being supplied to the same winding guide means.

8. A method according to any of claims 2 to 7, c h a r a c t e r i z e d by its use in a raising/lowering device for mutual height displacement of the two objects.

9. A method according to any of claims 2 to 7, c h a r a c t e r i z e d by its use as an operator device for opening and closing windows or doors, in

~~which said two objects are constituted by a stationary~~ frame structure and an openable sash structure.

10. A method according to any of claims 2 to 7, c h a r a c t e r i z e d by its use as a drilling instrument, said coupling member being connected with a drill or cutter head.

11. A method according to any of claims 2 to 7, c h a r a c t e r i z e d by its use for reversible mutual displacement of telescopically connected tube ~~members.~~

12. An apparatus for carrying out the method according to any of the preceding claims, c h a r a c - t e r i z e d in comprising, in connection with one of said two objects, a chain storage (10) with an elongate chain (11) of interlocking chain links (12) having a substantially circular curvature on their exterior sides and including associated engagement means, a guide means (13) for advancing the elongate chain (11), a winding guide means (14) connected with the advancing guide means (13) and comprising a guide (22) for engagement with a guide member (34) on the chain links for winding said helical winding (16), a rotatable driving device (3,4;15,26) arranged in said winding guide means (14) for axial advancement of the spindle device produced by the helical winding (5) and a coupling member (6,18) for coupling the helical winding with the other of said two objects.

~~13. An apparatus according to claim 13, c h a r a c t e r i z e d~~ in that said coupling means comprises a coupling member (6, 18) connected with an end turn of the helical winding.

14. An apparatus according to claim 12 or 13, c h a r a c t e r i z e d in that the chain storage (10) comprises an elongate track connected with the ~~advancing guide means (13) for receiving the chain (11)~~

which said two objects are constituted by a stationary frame structure and an openable sash structure.

10. A method according to any of claims 2 to 7, c h a r a c t e r i z e d by its use as a drilling instrument, said coupling member being connected with a drill or cutter head.

11. A method according to any of claims 2 to 7, c h a r a c t e r i z e d by its use for reversible mutual displacement of telescopically connected tube members.

~~12. An apparatus for carrying out the method~~ according to any of the preceding claims, c h a r a c - t e r i z e d in comprising, in connection with one of said two objects, a chain storage (10) with an elongate chain (11) of interlocking chain links (12) having a substantially circular curvature on their exterior sides and including associated engagement means, a guide means (13) for advancing the elongate chain (11), a winding guide means (14) connected with the advancing guide means (13) for winding said helical winding (16), a rotatable driving device (3,4;15,26) arranged in said winding guide means (14) for axial advancement of the spindle device produced by the helical winding (5) and means for coupling the helical winding with the other ~~of said two objects.~~

See next page

13. An apparatus according to claim 13, c h a - r a c t e r i z e d in that said coupling means comprises a coupling member (6, 18) connected with an end turn of the helical winding.

14. An apparatus according to claim 12 or 13, c h a r a c t e r i z e d in that the chain storage (10) comprises an elongate track connected with the advancing guide means (13) for receiving the chain (11) in its entire length.

15. An apparatus according to claim 12 or 13,

c h a r a c t e r i z e d in that the chain storage is constituted of a winch connected with the advancing guide means, on which winch the elongate chain is wound.

16. An apparatus according to any of claims 12 to 15, c h a r a c t e r i z e d in that the winding guide means (14) comprises a substantially part-cylindrical wall (21), on the interior side of which a guide (22) is provided for engagement with a guide member (34) on the chain links (12).

17. An apparatus according to claim 16, c h a r a c t e r i z e d in that which said guide is designed as at least one thread-rib (22) with a predetermined pitch across part of the interior side of said part-cylindrical wall (21).

18. An apparatus according to claim 17, c h a r a c t e r i z e d in that the advancing guide means (13) comprises a substantially linear guide rail (20) for controlled advancement of the chain links (12) towards the winding guide means and a guide surface (19, 24) for the exterior side (32) of the chain links, which guide surface is connected substantially in a tangential plane with the interior side of the part-cylindrical wall (21) of the winding guide means, said guide surface (19, 24) having near its connection to said interior side at least one advancing guide member (25)

19. An apparatus according to claim 18, c h a r a c t e r i z e d in that the advancing guide member (25) comprises a member protruding from the advancing guide surface (24) for introducing each chain link (12) into the winding guide means (14) with an axial displacement component.

20. An apparatus according to any of claims 16 to 19, c h a r a c t e r i z e d in that the drive means

comprises an advancing wheel (26), which is provided in a peripheral surface with a number of oblique teeth (27) having a predetermined second pitch directed opposite to the pitch of said thread-rib (22), said advancing wheel being journalled coaxially in the winding guide means (14) for engagement with the chain links (12) and being connected with a drive wheel (15) coupled to drive means via a transmission.

21. An apparatus according to claim 13 and any of claims 16 to 20, c h a r a c t e r i z e d in that said coupling member (18) is designed as a substantially disc-shaped cover member with a substantially circular edge surface (51), in which a guide member (52) is provided for engagement with said guide (22) in the winding guide means (14), whereas the cover member is provided, on one side surface (53), with protruding engagement means (54) for engagement with each their respective chain link (12) in the first turn (17) formed in the helical winding (16).

22. An apparatus according to claim 21, c h a r a c t e r i z e d in that said protruding engagement means (54) comprises a hook member (55).

23. An apparatus according to claim 21 or 22, c h a r a c t e r i z e d in that said protruding engagement means (54) comprises a groove (56).

24. An apparatus according to any of claims 21 to 23, c h a r a c t e r i z e d in that said guide member on the edge surface (51) of the coupling member (18) comprises a track (52) for receiving said thread-rib (22) in the winding guide means.

25. An apparatus according to any of claims 12 to 24, c h a r a c t e r i z e d in that the helical winding (5) formed by the winding of the chain links (1) is surrounded by a casing (8) of variable length.

26. An apparatus according to claim 25, c h a -

r a c t e r i z e d in that said casing is a bellow.

27. An apparatus according to any of claims 12 to 26, c h a r a c t e r i z e d in that a chain storage, advancing guide means and winding guide means are provided in connection with each of said two objects for producing two elongate spindle members (57, 58; 67, 68) by winding-up of two helical windings with opposite pitch directions.

28. An apparatus according to claims 13 and 27, c h a r a c t e r i z e d in that the two helical windings (57, 58) have the same diameter and that coupling members (63, 64) connected with the first produced turn (61, 62) of each winding are connected with each other intermediate said two objects.

29. An apparatus according to claim 19 and claim 27, c h a r a c t e r i z e d in that one of said helical windings (67) are advanced inside the other (68) and have chain links provided with an external threading (69) to engage an internal threading (70) formed by said helical track in the interior side of the chain links of the other helical winding (68) to enable each of said helical windings to function as a coupling member for the other helical winding.

30. An apparatus according to any of claims 12 to 29, c h a r a c t e r i z e d in that a single spindle device (75) is formed comprising a helical winding of alternating turns of chain links (76, 77) supplied from two separate sets of chain links.

31. An apparatus according to any of claims 12 to 30, c h a r a c t e r i z e d by its use in a raising/lowering device for mutual height displacement of the two objects.

32. An apparatus according to any of claims 12 to 30, c h a r a c t e r i z e d by its use as an operator device for opening and closing windows or doors,

in which said two objects are constituted by a stationary frame structure and an openable sash structure.

33. An apparatus according to any of claims 13 to 30, c h a r a c t e r i z e d by its use as a drilling instrument, said coupling member being connected with a drill or cutter head.

34. An apparatus according to any of claims 12 to 30, c h a r a c t e r i z e d by its use for reversible mutual displacement of telescopically connected tube members.

35. An elongate chain comprising interlocking chain links (12) with associated engagement means for use in an apparatus according to any of claim 12 to 34, c h a r a c t e r i z e d in that each chain link (12) has a substantially circular curvature on its exterior sides and, in unfolded projection, substantially the shape of a parallelogram with a first pair of engagement means (43, 44) for connection with neighbouring chain links in the same turn of the helical winding provided at a first pair of opposite sides (28, 29) and further engagement means (49, 50) for engagement with corresponding engagement means on adjacent chain links in neighbouring turns of the helical winding provided at a second pair of opposite sides (30, 31).

36. A chain according to claim 35 for use in an apparatus according to claim 17, c h a r a c t e r i z e d in that each chain link (12) is in its exterior side (32) with a track (34) adapted to receive said thread-rib (22) in the winding guide means, said track forming with said first pair of opposite sides (28, 29) an angle (v) adapted to said predetermined pitch.

37. A chain according to claim 36 for use in an apparatus according to claim 18, c h a r a c t e r i z e d in that an interior side (33) of each chain

links (12) is formed with engagement means (45) for engagement with the substantially linear guide rail (20) in the advancing guide means (13) and that said exterior side of each chain link (12) is provided with a second guide member (35) for introducing the chain link (12) into the winding guide means (14) with an orifice (38) of said track (34) orientated towards a first end (23) of said thread-rib (22), said orifice opening in the downstream side (28) of said first pair of opposite sides with respect to the direction of advancement.

38. A chain according to claim 37, c h a r a c t e r i z e d in that said second guide member (35) comprises a second track provided in said exterior side and ending in said first pair of opposite sides (28, 29) in track orifices (36, 37) displaced in a direction parallel to said first pair of sides (28, 29).

39. A chain according to any of claims 35 to 38 for use in an apparatus according to claim 20, c h a r a c t e r i z e d in that a guide member (39) is formed in an interior side (33) of each chain link (12), said guide member (39) being designed as a helical track which on the interior side of the helical winding (16) formed by the chain links forms a number of coherent helical tracks (42) with said second pitch for engagement with individual ones of the oblique teeth (27) of the advancing wheel (26) of said driving device.

40. A chain according to claim 37, c h a r a c t e r i z e d in that said engagement means (45) form part of a second pair of engagement means (45, 47) provided at said first pair of opposite sides (28, 29) and being brought into engagement with opposite means on neighbouring links in the same turn (17) by the winding of the chain links, to retain the chain links

(12) in their positions in said winding.

41. A chain according to any of claims 35 to 40 for use in an apparatus according to claim 22, c h a r a c t e r i z e d in that the first pair of engagement means for each chain link (12) comprises a hook-shaped hinge member (44) and a curved track (43) for receiving said hinge member (44), respectively, said curved track (43) being adapted to receive the hook member (55) of said coupling member (18).

42. A chain according to claim 40 and 41 for use in an apparatus according to claim 18, c h a r a c - t e r i z e d in that said second pair of engagement means for each chain link (12) comprises as a fork member (45) provided at a free edge of a wall portion defining said curved track (43) for engagement, on one hand, with said guide rail (20) in the advancing guide means (13) and, on the other hand, with a rib member (47) provided in an interior side of said hook-shaped hinge member (44), said fork and rib members (45, 47) preventing mutual displacement of neighbouring chain links in the same turn in the axial direction of the helical winding by engagement with a rib member (47) and a fork member (45), respectively, on each of respective neighbouring chain links, the hook-shaped hinge member (44) being provided, on each side of said rib member (47), with abutment surfaces (48a, 48b) serving as stop for branches (45a) of said fork member (45) for retaining neighbouring chain links in a predetermined angular position in said turn.

43. A chain according to claim 42, c h a r a c - t e r i z e d in that said mutually engaging fork and rib members (45, 47) are positioned in such a way relative to one another that said curved tracks (43) on a chain link (12) are brought into engagement with hook-shaped hinge members (44) in chain links posi-

tioned side by side in the same turn and a neighbouring turn.

44. A chain according to any of claims 35 to 43 for use in an apparatus according to claim 23, c h a r a c t e r i z e d in that said further engagement means comprises a track (49) in the exterior side (32) of the chain link (12) and a rib member (50) along one side and the other, respectively, of said second pair of opposite sides (30, 31), said rib member (50) being adapted to engage the groove (56) on said coupling member (18).

45. A chain according to any of claims 35 to 44, c h a r a c t e r i z e d in that each chain link (12) has a length different from an even fraction of a circle having the radius of said helical winding.

46. A chain according to claim 45, c h a r a c - t e r i z e d in that the length of each chain link (12) constitutes an odd fraction of a circle.

47. An apparatus according to claim 46, c h a r- a c t e r i z e d in that the length of each chain link (12) constitutes a fifth of the peripheral length of the interior wall side of the winding guide means (14).

48. A chain according to any of claims 35 to 47, c h a r a c t e r i z e d in that the chain links (12) are moulded from plastics material.

49. A chain according to any of claims 35 to 47, c h a r a c t e r i z e d in that the chain links (12) are made as cast or sintered metal bodies.

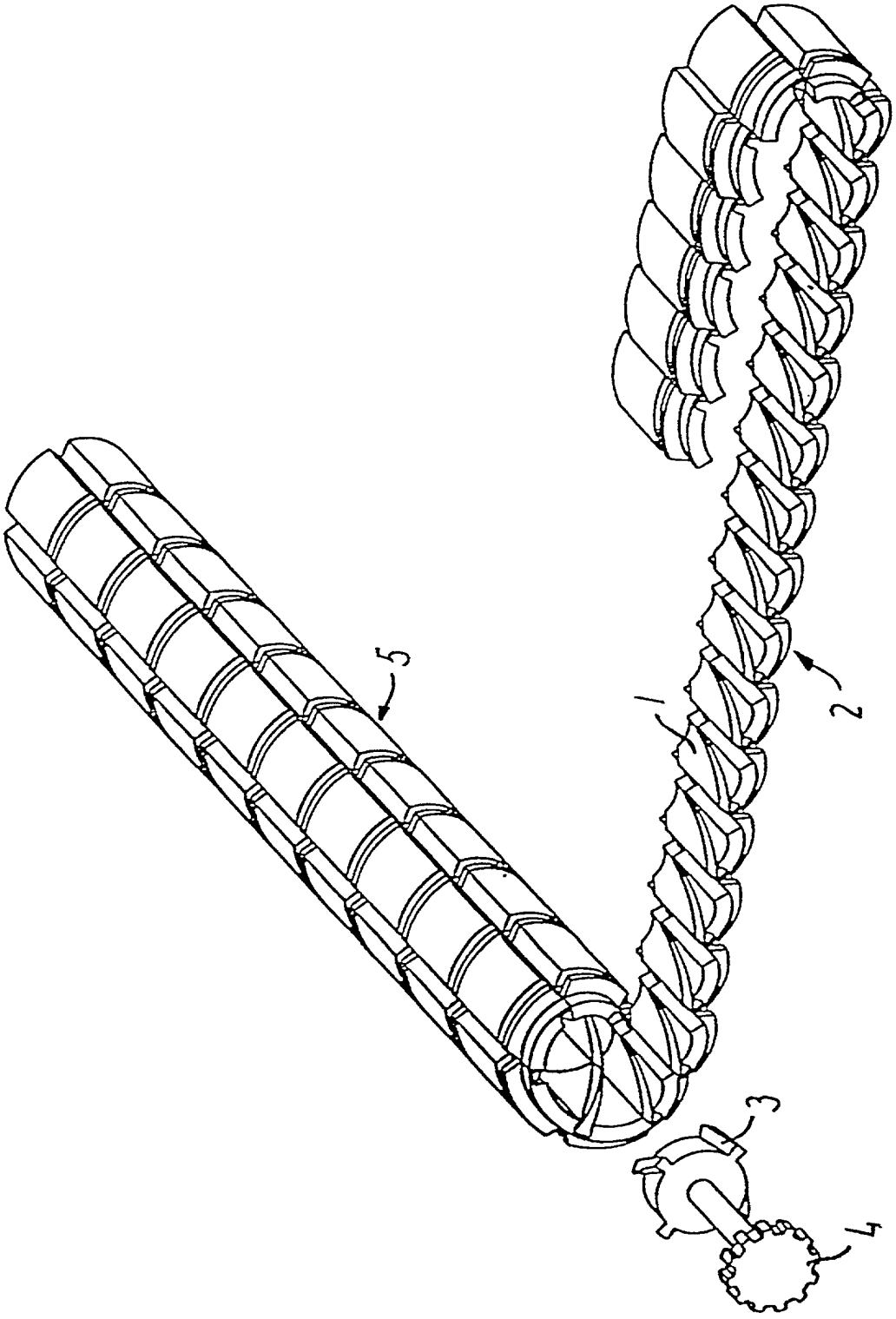

FIG.1

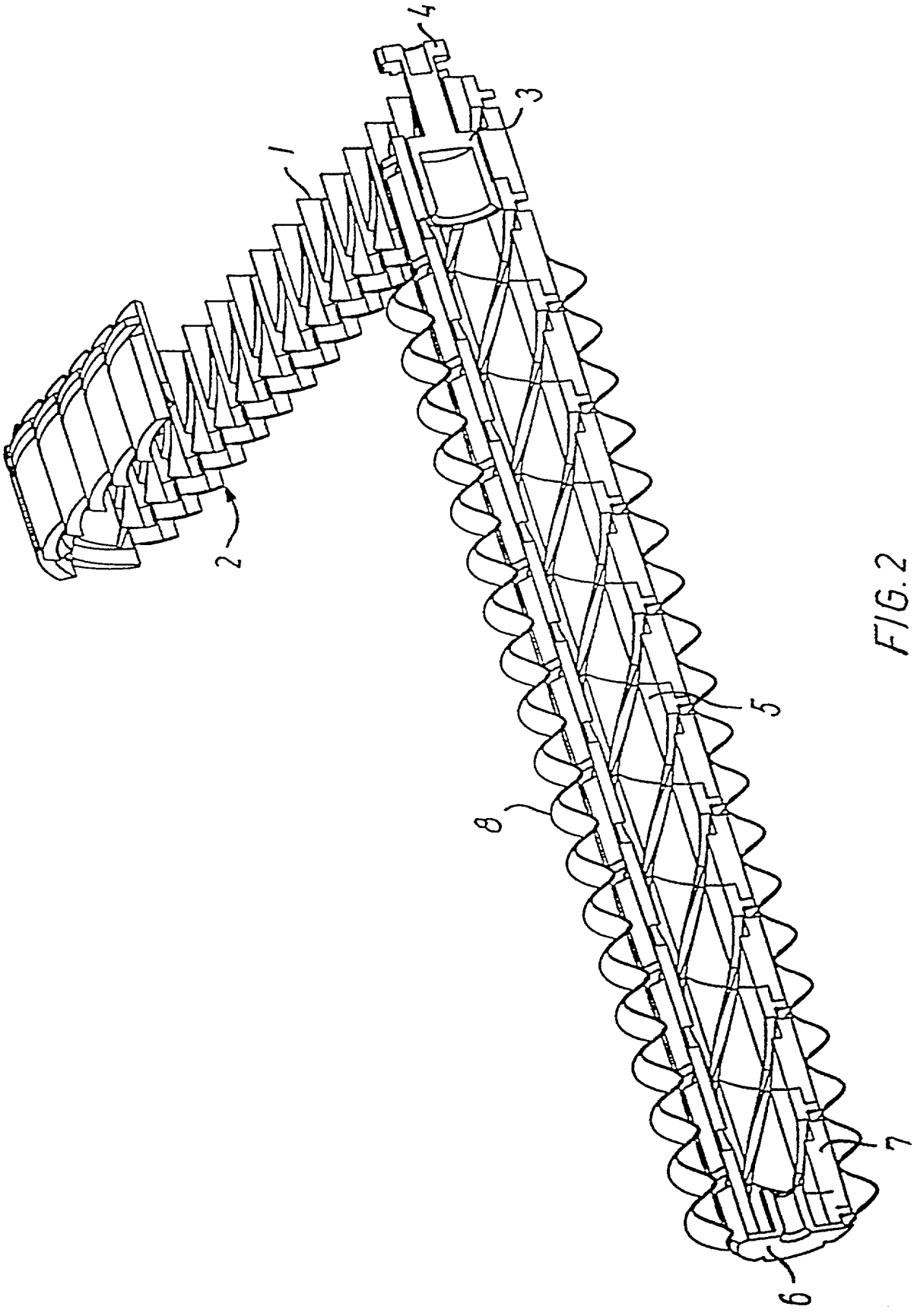

FIG.2

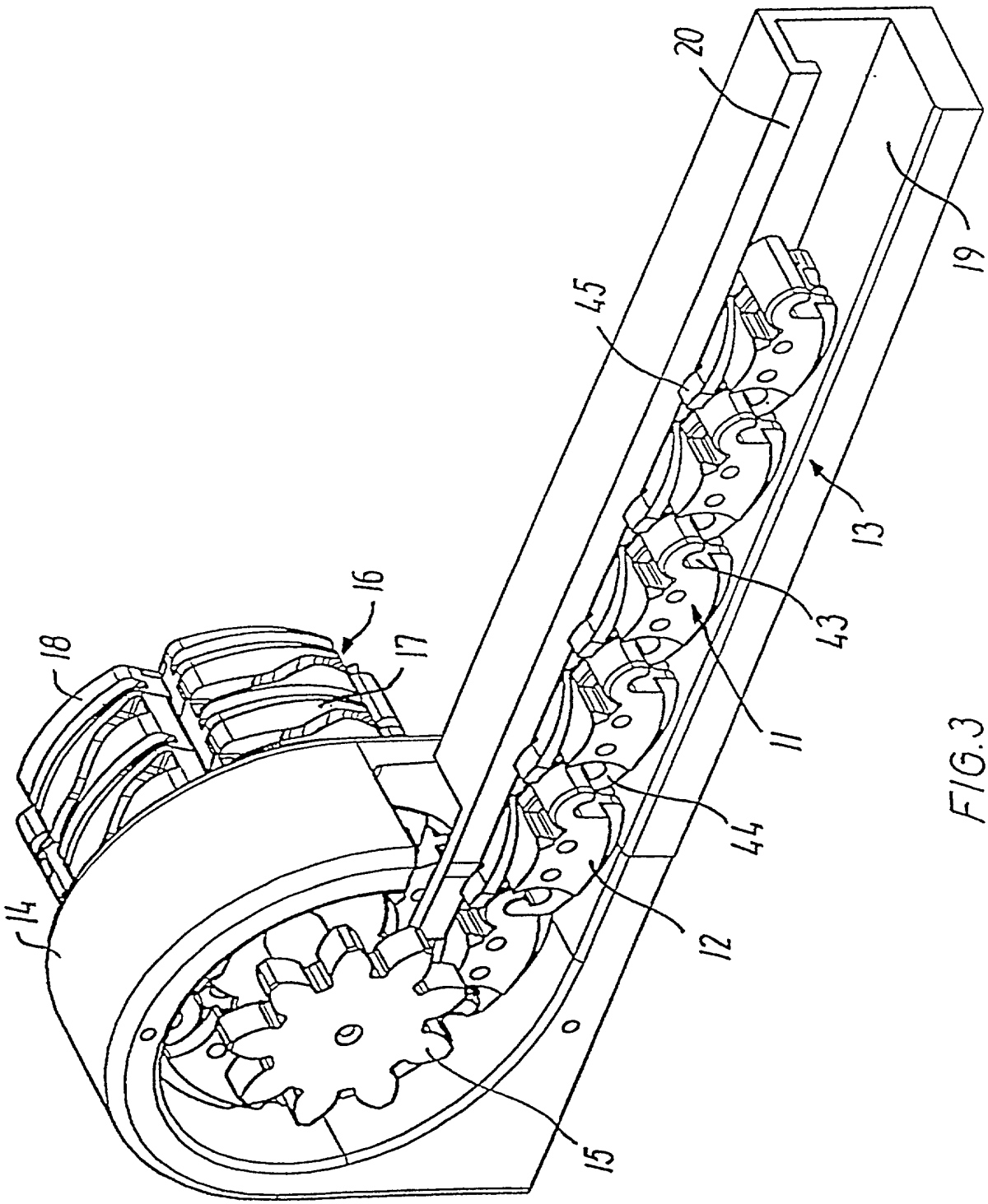

FIG.3

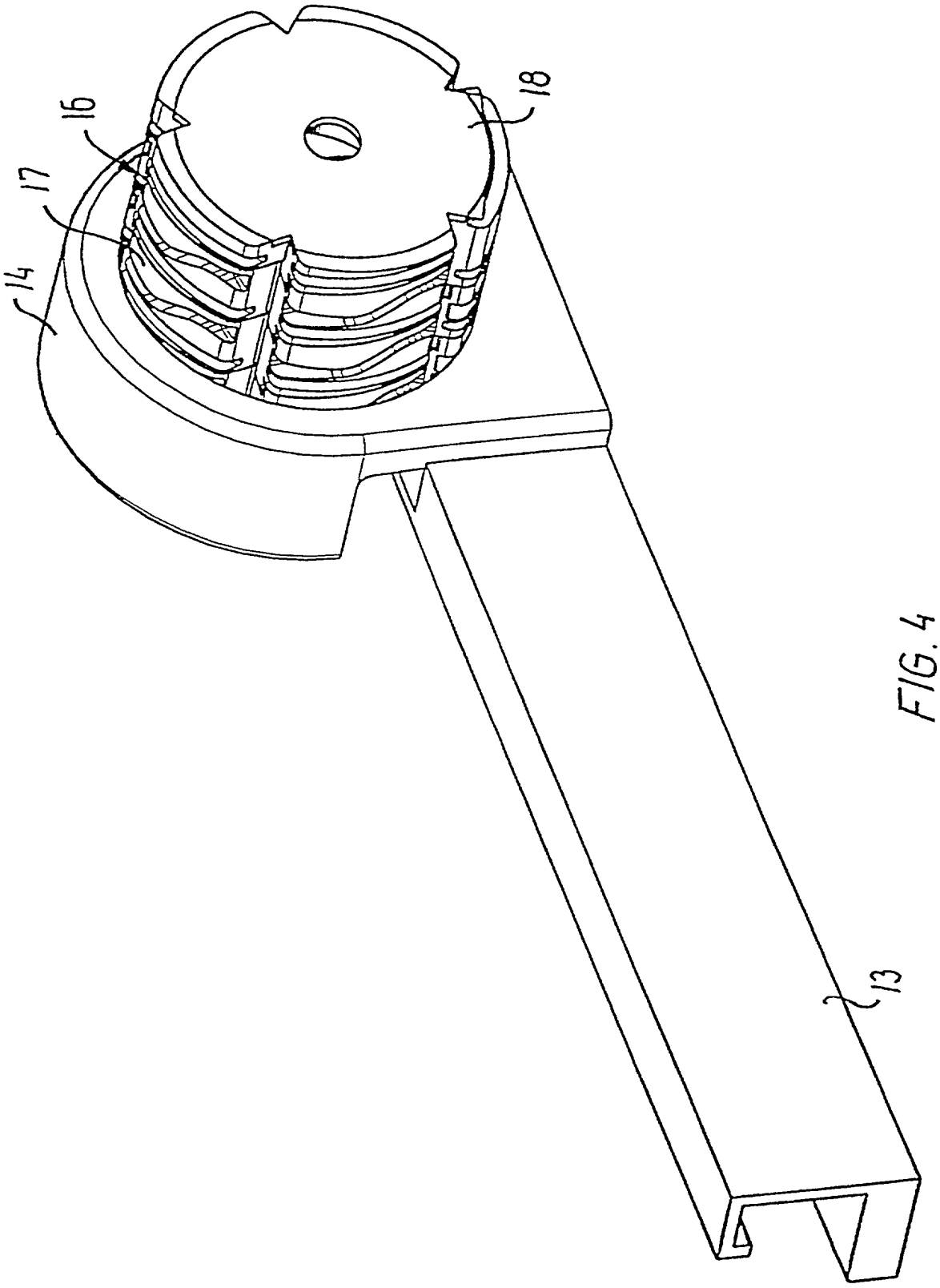

FIG. 4

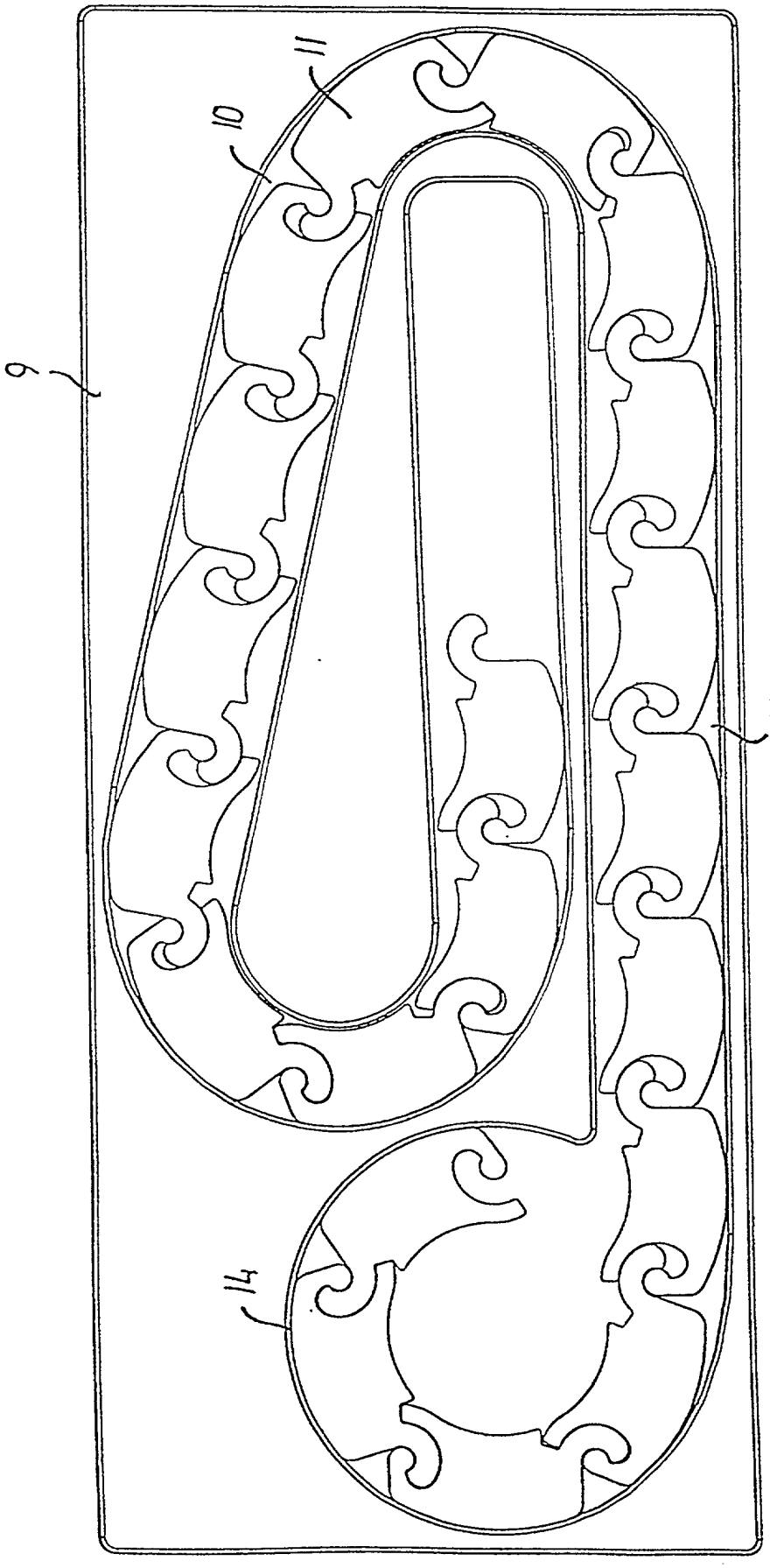

FIG.5

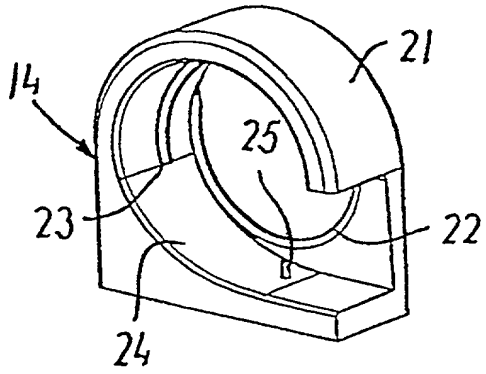

FIG.6

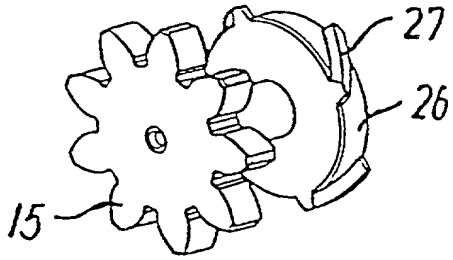

FIG.7

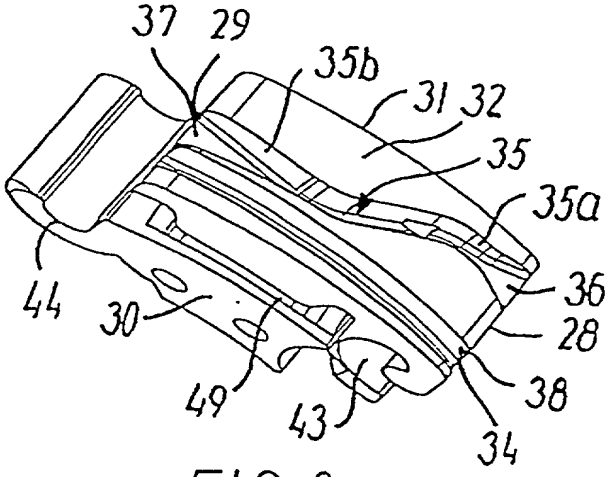

FIG.8

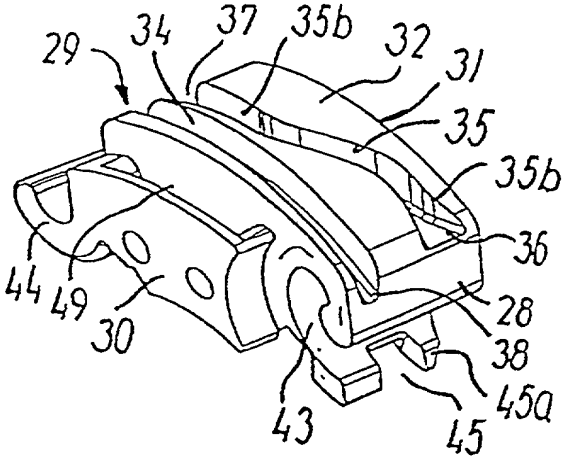

FIG.9

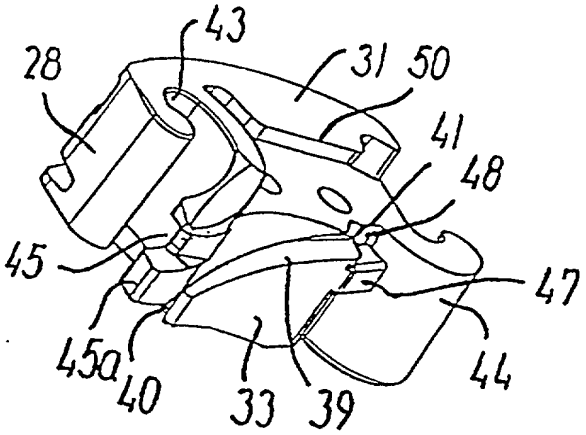

FIG.10

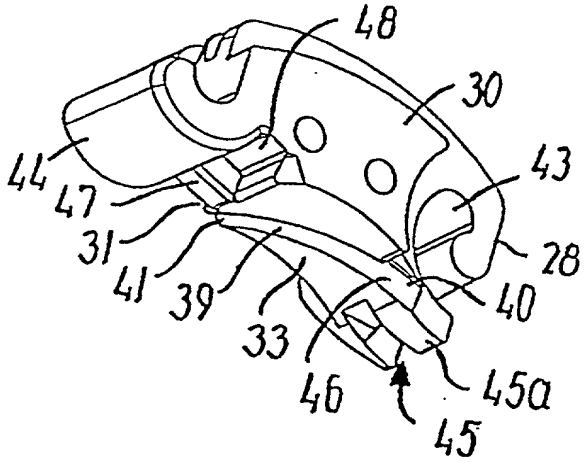

FIG.11

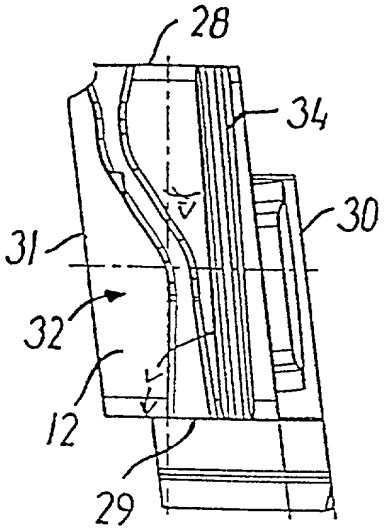

FIG. 12

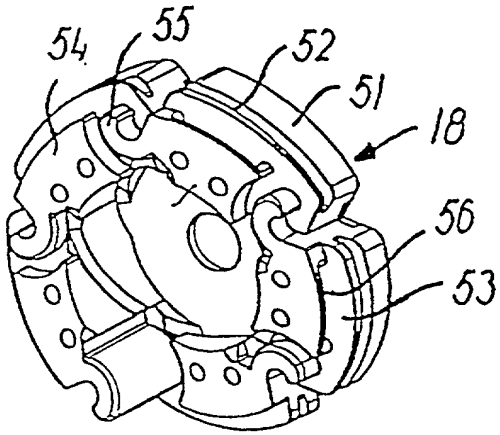

FIG. 13

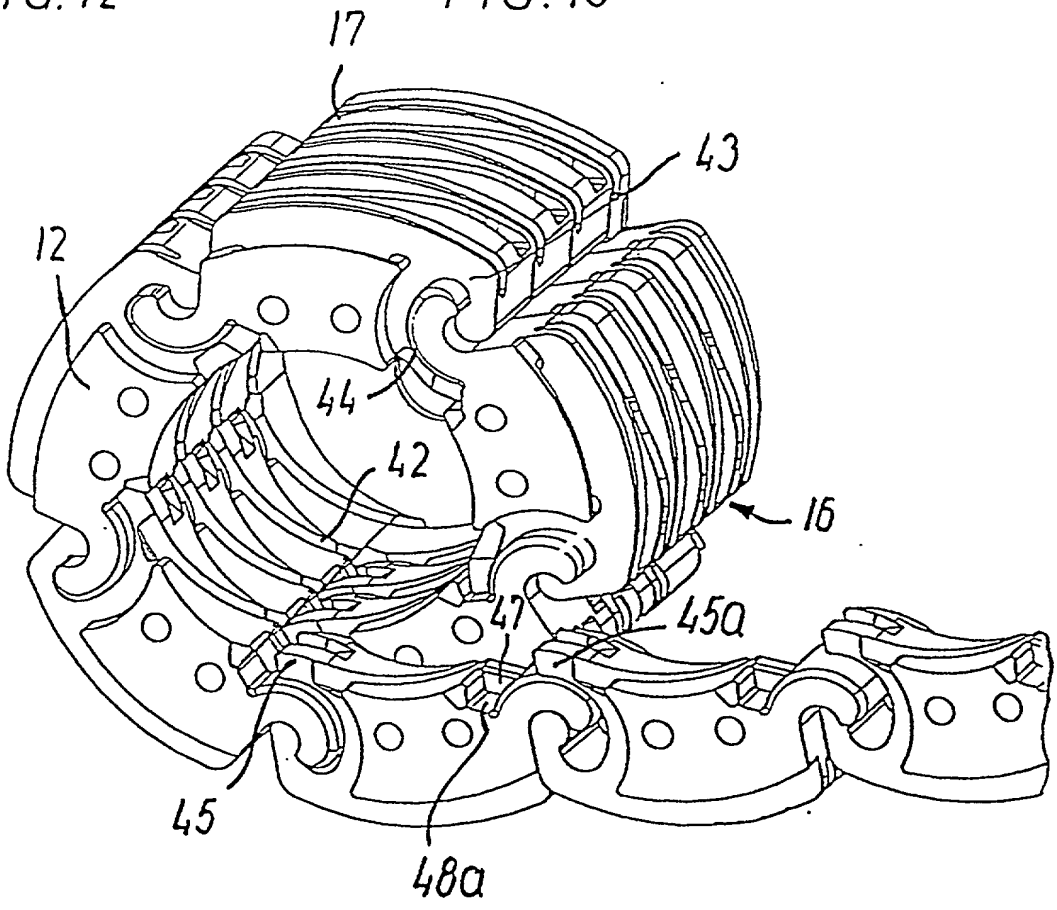

FIG. 14

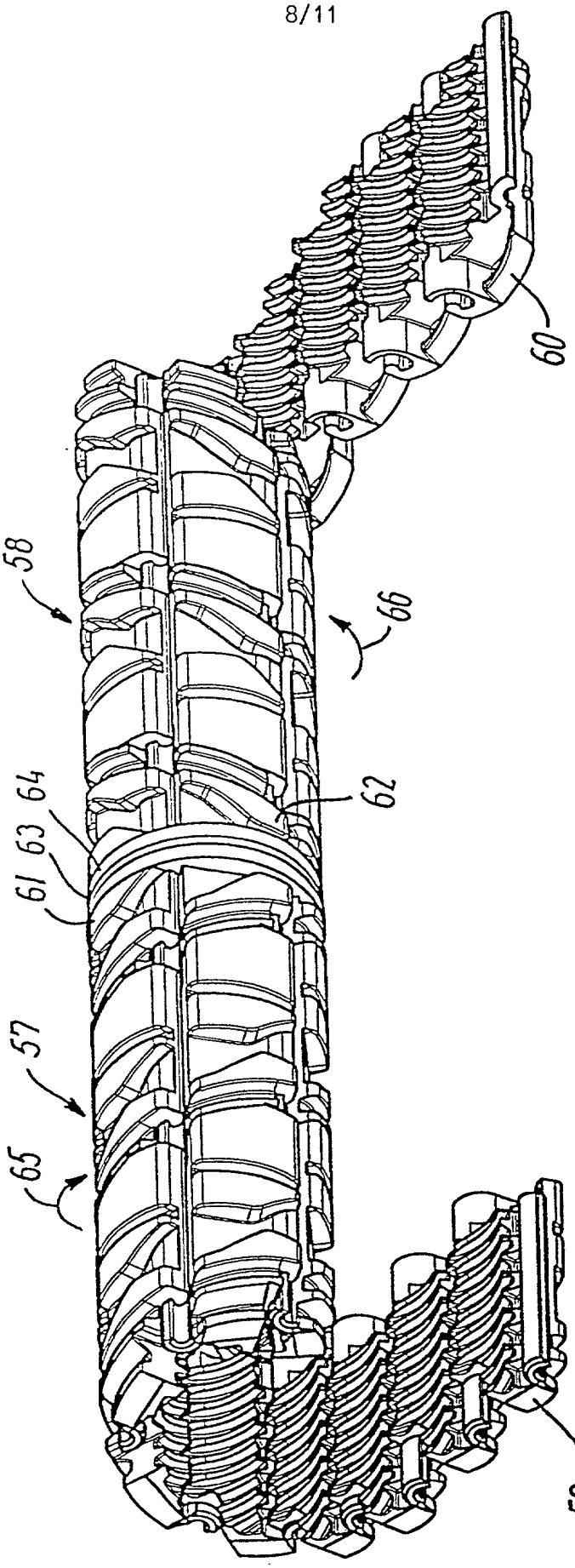

FIG. 15

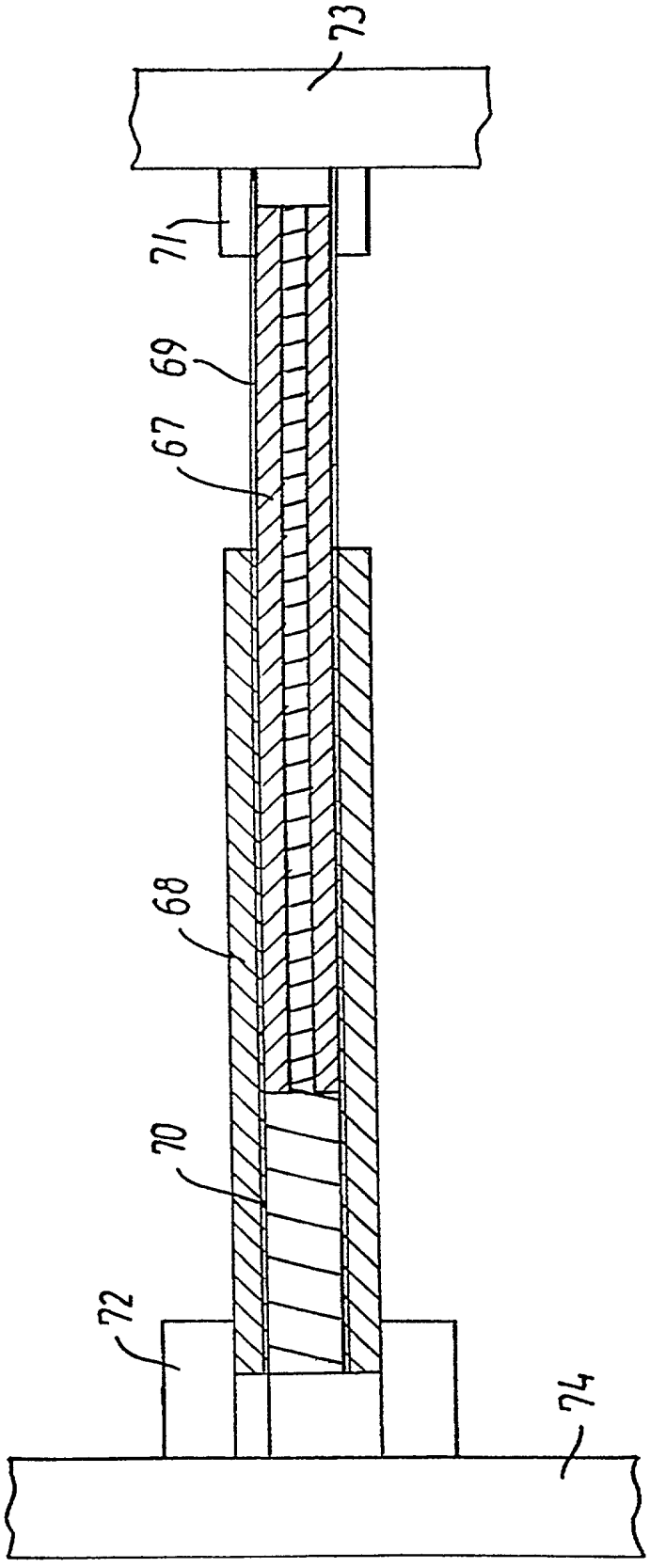

FIG. 16

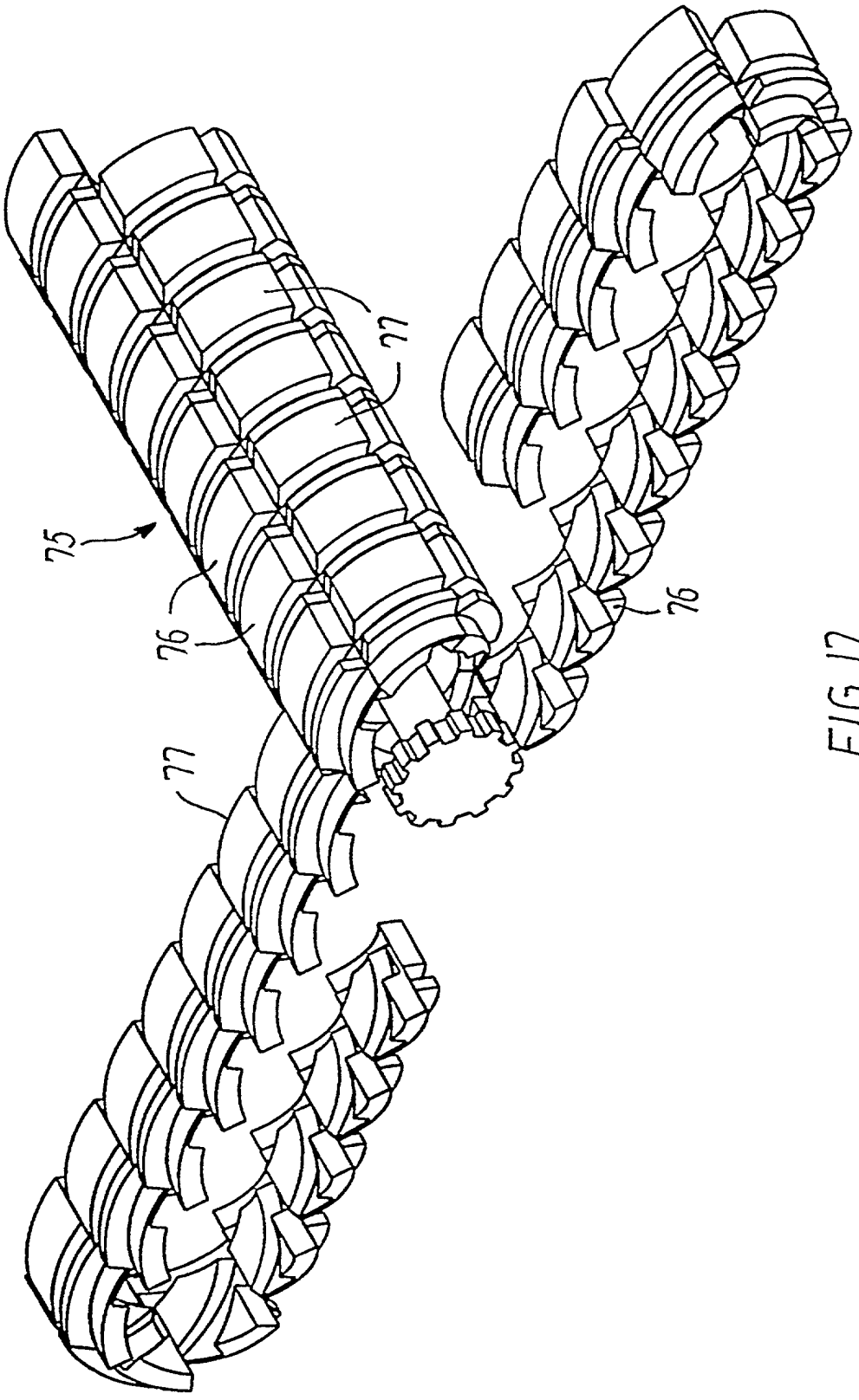

FIG. 17

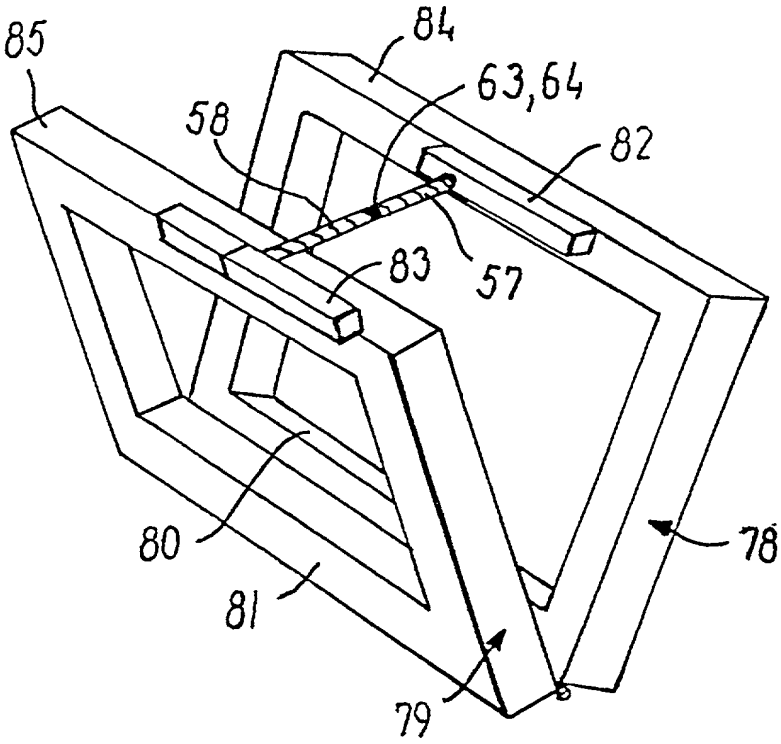

FIG.18

DECLARATION FOR UNITED STATES PATENT APPLICATION
POWER OF ATTORNEY, DESIGNATION OF CORRESPONDENCE ADDRESS

Attorney Docket _____

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name, and that I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled *A METHOD AND AN APPARATUS FOR TRANSFER OF PRESSURE AND/OR TENSILE LOAD AND AN ELONGATE CHAIN*, the specification of which *FOR USE THEREIN*

[ ] is attached hereto.
[ ] was filed on _____, as Application No. _____, and was amended on _____ [if applicable].
[X] was filed under the Patent Cooperation Treaty on *25.03.99* Serial No. *PCT/DK99/00171*, the United States of America being designated.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, 119 of any foreign application(s) for patent, utility model, design or inventor's certificate listed below and have also identified below any foreign application(s) for patent, utility model, design or inventor's certificate having a filing date before that of the application(s) on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
Number	Country	Date Filed	Yes	No
0512/98	*Denmark*	*08 April 1998*	*X*	

I hereby appoint the following attorneys and agents to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: George H. Spencer (Reg. No. 18,038), Robert J. Frank (Reg. No. 19,112), Norman N. Kunitz (Reg. No. 20,586), Gabor J. Kelemen (Reg. No. 21,016), John W. Schneller (Reg. No. 26,031), Marina V. Schneller (Reg. No. 26,032), Robert Kinberg (Reg. No. 26,924), Allen Wood (Reg. No. 28,134), Ashley J. Wells (Reg. No. 29,847), James R. Burdett (Reg. No. 31,594), Michael A. Gollin (Reg. No. 31,957), Catherine M. Voorhees (Reg. No. 33,074), G. Abe Zachariah (Reg. No. 38,366), Julie A. Petruzzelli (Reg. No. 40,769), Catherine A. Ferguson (Reg. No. 40,877), Michael A. Sartori (Reg. No. 41,289), Charles C. P. Rories (Reg. No. 43,381), Keith G. Haddaway (Reg. 46,180), Richard L. Aitken, (Reg. No. 18,791); Clifton E. McCann, (Reg. No. 29,565); John P. Shannon, (Reg. No. 29,276); Andrew C. Aitken, Registration (No. 36,729); Laurence J. Marhoefer, (Reg. No. 21,091), and Ralph P. Albrecht, (Reg. No. 43,466) all at Suite 1000, 1201 New York Avenue, N.W., Washington, D.C. 20005-3917, Telephone: (202) 962-4800, Telefax: (202) 962-8300. Address all correspondence to VENABLE, Post Office Box 34385, Washington, D.C. 20043-9998.

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The undersigned hereby authorizes the U.S. attorneys named herein to accept and follow instructions from the undersigned's assignee, if any, and/or, if the undersigned is not a resident of the United States, the undersigned's domestic attorney, patent attorney or patent agent, as to any action to be taken in the Patent and Trademark Office regarding this application without direct communication between the U.S. attorneys and the undersigned. In the event of a change in the person(s) from whom instructions may be taken, the U.S. attorneys named herein will be so notified by the undersigned.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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